

*Lanson
have*

department of WATER & SEWERS annual report

628
C49ar
1970, pt.1

1970



STATE WATER SURVEY DIVISION
LIBRARY COPY

JUL 02 1971

CITY OF CHICAGO, RICHARD J. DALEY, MAYOR

Chicago City Council 1970

HON. RICHARD J. DALEY
Mayor

JOHN C. MARCIN
City Clerk

CLAUDE W.B. HOLMAN
President Pro Tem

MORTON A. GORDON
Deputy City Clerk

ALDERMEN

Ward

1. Fred B. Roti
2. Fred D. Hubbard
3. Ralph H. Metcalfe
4. Claude W. B. Holman
5. Leon M. Despres
6. A. A. Rayner, Jr.
7. Nicholas J. Bohling
8. William Cousins, Jr.
9. Dominic J. Lupo
10. John J. Buchanan

Ward

11. M.
- 12.
- 13.
- 14.
- 15.
- 16.
- 17.
- 18.
- 19.
- 20.

Michael Colleta
Sergeant-at-Arms

Assist

(a) Deceased De

ILLINOIS STATE WATER SURVEY LIBRARY COPY

DATE DUE

628 City of Chicago, Department
C49ar ANNUAL REPORT,
1970, pt.1 DEPARTMENT OF WATER
07081003 AND SEWERS, CITY OF
 CHICAGO.

DATE	ISSUED TO

628 City of Chicago, Department
C49ar ANNUAL REPORT,
1970, DEPARTMENT OF WATER
pt.1 AND SEWERS, CITY OF
07081003 CHICAGO.



1970 ANNUAL REPORT
DEPARTMENT OF WATER AND SEWERS
CITY OF CHICAGO

DEMCO

discharged their responsibilities and our gratitude for the cooperation we have received from the various governmental agencies, industrial organizations and, most of all, the public we are so proud to serve.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "James J. Daley".
Commissioner

Ward
41. Edward T. Scholl
42. Raymond K. Fried (c)
43. G. Barr McCutcheon
44. William S. Singer
45. Edwin P. Fifieldski
46. Joseph R. Kerwin
47. John J. Hoellen
48. Robert J. O'Rourke
49. Paul T. Wigoda
50. Jack I. Sperling

C.R. Berek
Managing Editor
Council Journal

1970

s of the Department of
70.

een in the process of
responsibility for its
s ago, supplied a safe,
0 residents of Chicago
pletely self-supporting
s two largest water
ribs; eleven pumping
35 miles of mains. All
directly or financed by
\$68,523,794.

maintains the Chicago
storm drainage within
roximately 4,100 miles
ipe to the large semi-

City Council, for your
hat we shall strive to
e of the citizens of our
r appreciation to the
anner in which they

.

.

.

.

.

.

.

.

.

.

.

.

Highlights

A total of over 377 billion gallons of water, averaging 1 billion, 35 million gallons per day, was pumped through the water distribution system during the year.

Total receipts of the Water Collection Division amounted to \$69,596,414 in 1970. Of this amount, \$68,523,794 was collected for Water Fund revenue items.

Investments in capital improvements in the Chicago Water System totaled \$7,847,528 in 1970 and programmed expenditures for capital improvements for the period 1970 to 1974 call for a total of approximately \$108,053,000.

More than 17 miles of new water mains and 13.5 miles of new sewers were constructed in 1970. Also, 543 new catch basins and 382 new manholes were added to the sewerage system.

New records for peak hour and total pumpages were established during 1970 when, on July 1st, more than 1 billion, 723 million gallons of water were pumped for the day, with the highest hourly rate of 2 billion, 300 million gallons a day at 4:00 P.M.

The program to convert the boiler equipment in the five steam-operated pumping stations to the use of natural gas fuel instead of coal (with oil as a secondary or stand-by fuel) is more than half completed. All boilers in the Western Avenue Pumping Station are now gas-fired.

The connection between the Central Water Filtration Plant and the Chicago Avenue Tunnel (from the William E. Dever and the Carter H. Harrison Cribs) was completed in 1970 and the tunnel was placed in service on Christmas Eve. This raw water tunnel provides a second source of water for this plant, thus insuring its dependable operation.

During 1970, the hydraulic system which operates the large discharge valves on each of the Central Water Filtration Plant's eight low-lift pumps was completely revamped. These pumps raise the water to a level sufficient to provide for the gravity flow of the water as it travels through the plant. Now each individual pump can be taken out of operation for repair. Formerly, no less than four pumps could be isolated at the same time, so whenever a pump was being repaired, only half the plant could be operated.

A total of 758,866 water samples were labora-

tory-tested during the year—to average almost 2,080 a day.

In 1970, the Bench and Grade Section of the Bureau of Sewers' Engineering Division established elevations for 29 new street grades and 246 standard bench monuments and ordinary benches.

A new flameless atomic absorption method of testing was developed in the laboratory to determine the presence of mercury, a highly toxic metal, in water. This modern analysis procedure is accurate in extremely low ranges, with detectability down to less than one-tenth parts per billion.

A total of 17,053 visitors toured the Central Water Filtration Plant during 1970. Among the tourists were technicians and professionals interested in water treatment methods, but most were students of all levels of education, including many grammar school pupils. Also, 165 foreign visitors from 21 different countries took part in the tours.

The new John R. Baylis Library was formally dedicated on July 30, 1970. Also during the year, the Department of Water and Sewers became a contributing institutional member of the John Crerar Library, thereby broadening the library service available to the management and technical staff of this Department.



FUTURE GROWTH

Mayor Richard J. Daley congratulates Commissioner James W. Jardine as he is named "Water Utility Man of the Year" during convention of Illinois Section of American Water Works Association.



Future Growth

The urgent need for realistic advance planning for water and sewer facilities, which are so vital to public well-being, is quite obvious. The Chicago Water System has been in the process of continual development since the responsibility for its operation was assumed by the City of Chicago in 1852.

The community of Chicago can be said to have begun in 1803 with the building of Fort Dearborn. This frontier settlement first drew water from the Chicago River but when it soon became polluted the settlers were compelled to resort to private shallow wells or the Lake. In 1834, the village trustees built a public well at Hubbard Street and Wabash Avenue, and individual consumers carried water in buckets from this well to their homes. Also, resourceful hawkers with mule-drawn carts sold water by bucketfuls from door to door.

The first water system to serve residents of Chicago cost \$24,000 and was privately owned. It began operating in 1842. Lake water was pumped to an elevated wooden tank from which it flowed by gravity through wooden pipes under the streets. With the rapid expansion that young Chicago was then undergoing, however, it was soon apparent that only public ownership of the water system could supply enough operating capital to build the needed facilities. Therefore, in 1852 the City of Chicago purchased the private Chicago City Hydraulic

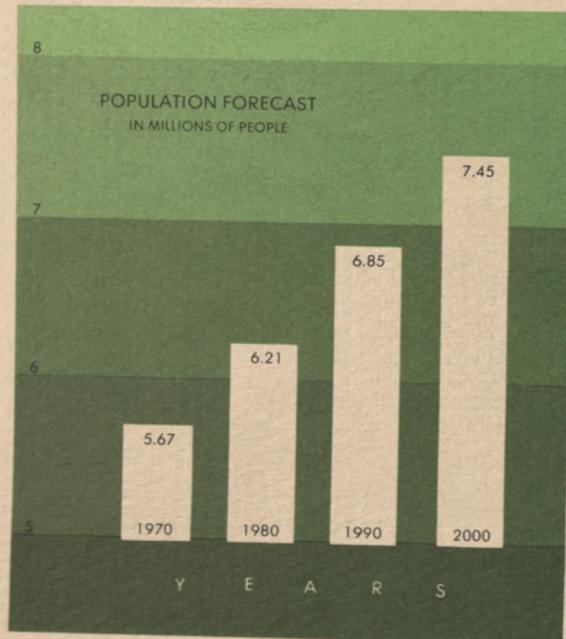
Company and constructed a new water system which was put into operation during 1854.

With the mass movement of European immigrants to the Midwest, the City repeatedly outgrew its water system and was constantly subjected to water problems. The Great Chicago Fire of 1871 emphasized the need for a multi-unit water system which no single calamity would be able to destroy. This motivated the construction on what ultimately developed into the present network of cribs, tunnels, pumping stations, filtration plants and interconnecting mains known as the Chicago Water System.

For awhile, drainage presented no great problem to the early settlers of Chicago. Open ditches served to carry storm runoff back to Lake Michigan. State Street was drained by trenches that channeled water to the Chicago River. It was from this simple beginning that the present Sewerage System has been developed. During 1856, sewers were constructed in the Loop district and by 1861 Chicago covered 18 square miles and had installed 54 miles of sewers with 2,400 house drains connected to them.

During the years that followed, the City continued to increase in population and land area, but its sewage disposal problems increased even faster. As more and more untreated sewage poured into the Chicago River and the Lake, an ever-widening fringe of pollution was created along the lakefront at the mouth of the River and at sewer outlets. Ultimately it was established that the germs carried in the sewage were the underlying cause of the periodic epidemics of cholera, typhoid and other water-borne diseases.

After extensive studies, a Water Supply and Drainage Commission appointed in 1886, recommended that a 28-mile drainage canal, now known as the Sanitary and Ship Canal, be built between the south branch of the Chicago River and Lockport. This recommendation was carried out by the Metropolitan Sanitary District of Greater Chicago, which was authorized by the State Legislature in 1889 and established in 1890. After completion of the Canal in 1900, the river was reversed to flow southwesterly to the Des Plaines River at Lockport, thus removing a major source of pollution from the Lake. Interceptor sewers were built along the lakefront to intercept the sewers which emptied into the Lake, and the Sanitary District built



Population forecast for Cook County (including Chicago), as projected by engineering and management consultants.

interceptor sewers along the Chicago River to stop the City sewers from emptying into the river. Other canals, locks and special structures were constructed by the District to further protect the City water supply.

Since the turn of the century, population growth and industrial expansion have made ever-increasing demands on the Chicago Water System. During the last 30 years, the number of persons served by the System has grown by almost a million. At the close of 1940, Chicago and 39 suburban communities were being supplied water by the Chicago System. Its distribution facilities consisted of 3,837 miles of water pipe, 41,295 fire hydrants, 38,965 gate valves and 115,174 meters. Demands for water in the future will depend primarily upon the population of the areas that will be served. The anticipated intensity of such demands determines the degree to which facilities must be expanded and improved.

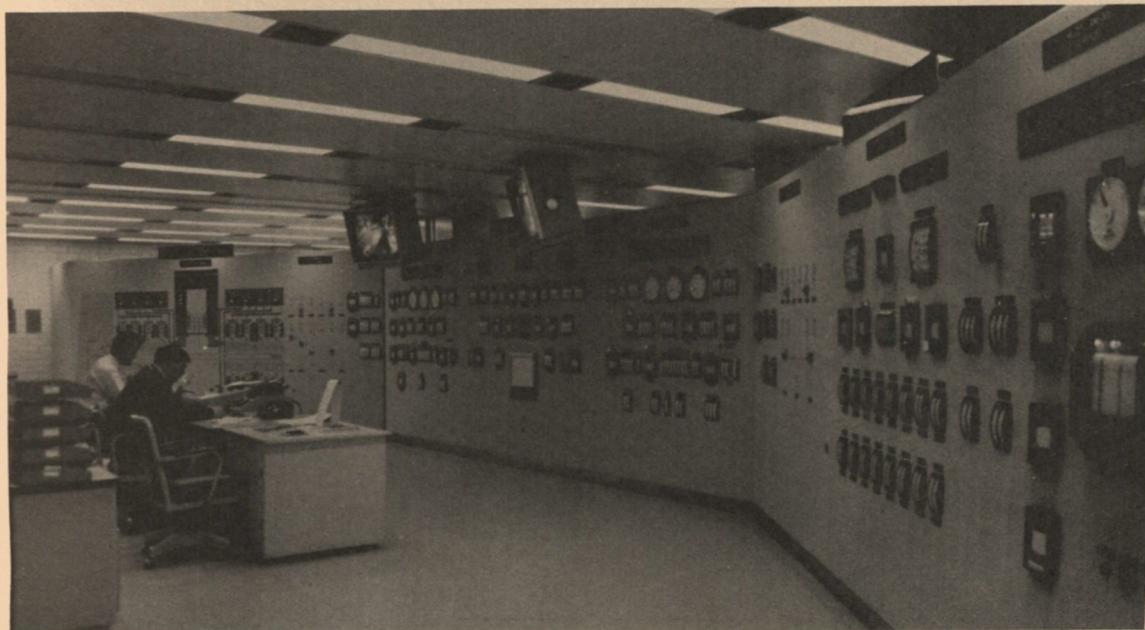
At the end of 1970, 72 suburbs relied upon the Chicago Water System for their supply of water —33 more than during 1940. It is projected by private engineering consultants that by the year 2000 a total of 94 suburban communities will be served by the System. The suburbs benefit from Chicago's experienced water system administration. Its work force, which by demonstrating its capability, has proven itself qualified to assume the necessary responsibili-

ties for the water system construction, operation and maintenance activities.

What comprises but a portion of the Chicago Water System's services would be a major undertaking for the individual community. Because of its proven ability to plan and build in advance, Chicago is readily able to expand its System to furnish the additional services as needed. Since 1940, nearly 300 miles of water mains, 4,730 fire hydrants, and 2,125 gate valves have been added to the water distribution system within the corporate limits of the City of Chicago.

As a vital aid toward the insurance of an adequate supply of highest quality water in quantities sufficient to meet all present and future needs, whether they be for domestic, commercial, industrial or recreational purposes, the Department annually prepares a Five-Year Capital Improvement Program. This program, designed to provide the necessary water and sewerage facilities when and where needed, is developed in cooperation with the Department of Public Works and the Department of Development and Planning. It is reviewed and revised annually to make certain that we will continue to meet the growing responsibilities of the Department.

The Department of Water and Sewers participates also in the Five-Year Joint Capital Improvements Program for Chicago. The Municipal Code



The central control panel at the Central Water Filtration Plant monitors water flow, chemical feed, elevation, chemical analysis and meteorological conditions.

of Chicago provides that it shall be the duty of the Department of Development and Planning to ".....coordinate the formulation and execution of physical improvement projects and programs affecting the present and future development of the City; to coordinate the development of a long-range capital improvements program."

The preliminary program prepared for the period of 1970 to 1974 calls for the estimated expenditure of \$108,053,000 for improvements in the Water System's tunnels and shafts, filtration plants, pumping stations and distribution system. The map on pages 12 and 13 indicates the service area of the Chicago Water System (the City of Chicago and 72 suburban communities, covering a total area of 440 square miles) and location of facilities.

In the process of formulating plans, it is imperative that population growth and movement trends be studied. Factors which might influence the future distribution service areas must be considered. Effective planning includes: estimates of water demands throughout the area and expected changes in demands by area segments; the study of the capabilities of the present facilities to meet current and future requirements; a construction program that will insure that new facilities are ready when needed to provide continuous service at a satisfactory level; and an appraisal of prospective operating expenses and revenues essential to a sound

program. Engineering and management consultants are employed to aid in planning for the years ahead.

During 1968, a seven-year program was initiated at the South Water Filtration Plant, aimed toward the replacement of existing plant instrumentation and related facilities with the most modern plant and equipment. When the goal of this program has been attained, the South Plant will be monitored by a computer-data logger and the chemical feed system will have been completely automated, using equipment similar to that in use at the Central Water Filtration Plant.

At the end of 1970, work on this program had reached about 25 per cent completion. Engineers now are working on the design of the equipment for the new chemical control laboratory; a new chemical building addition, a new control room instrument panel and the automated chemical feed system.

On August 24, 1970, the Chicago City Council authorized the sale of Water Certificates of Indebtedness in the amount of 25-million dollars. These borrowed funds will be used to defray a portion of the capital improvement costs during the next few years.

The Chicago Water Fund enjoys a relatively low rate of indebtedness. As of September 30, 1970, \$533,186,623 has been invested in the Chicago Water System's plants and facilities and the bonded indebtedness is only \$175,500,000. This comparison is even more impressive when it is noted that the present-day total replacement value of the System is estimated at well over one billion dollars.

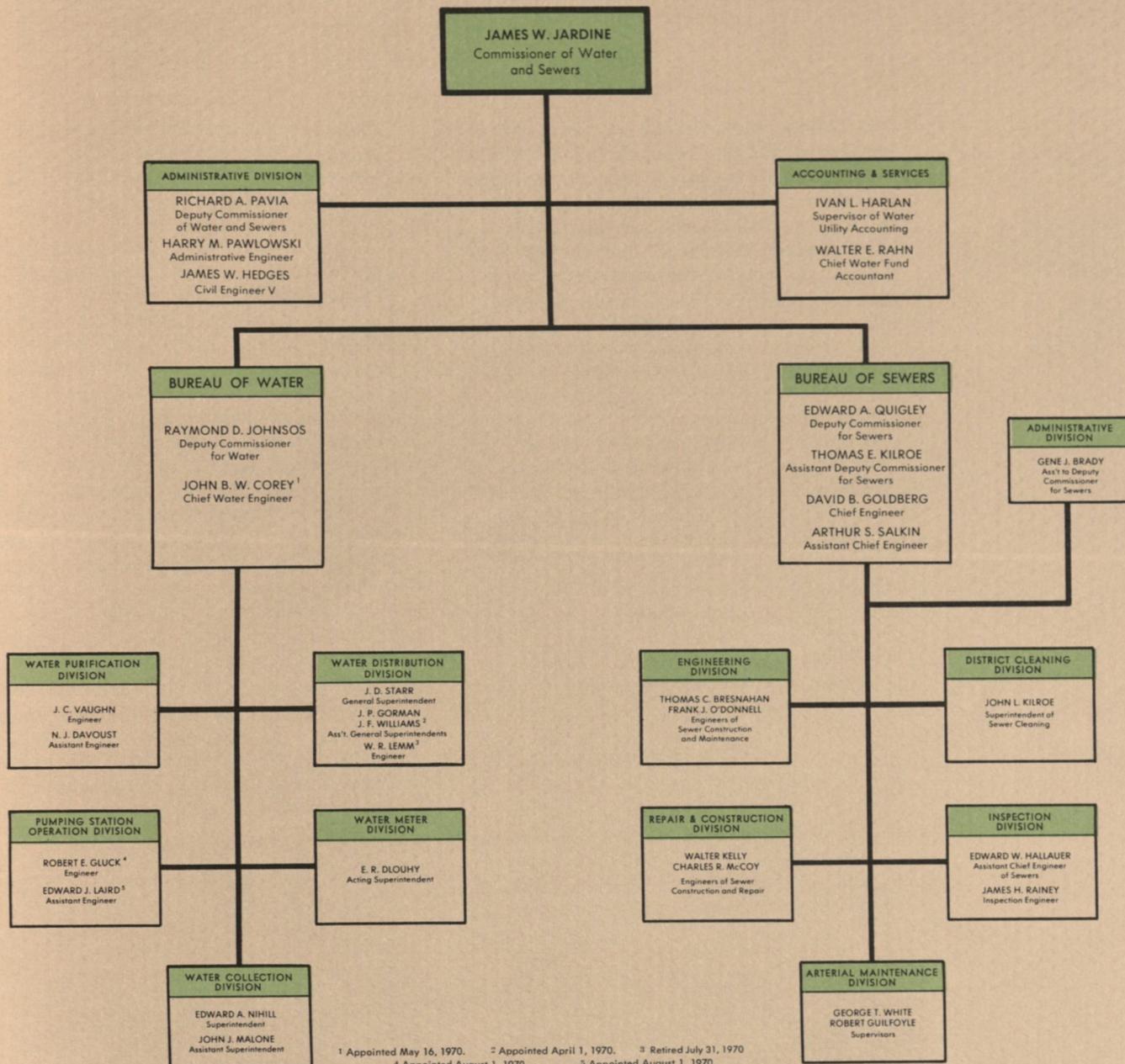
During the past 30 years, the Chicago Water Fund financed about two-thirds of the Water System's major construction projects from the sale of Water Works Certificates of Indebtedness, and over half of the total of the some 533-million dollars invested during the entire life of the System was expended in the last 13 years.

The Bureau of Water is responsible for the operation of a public utility that pumps more water through services controlled by meters to domestic and industrial consumers than any other water system in the world. Such service requires the know-how of specialized personnel in the fields of management, engineering, finance, chemistry, bacteriology, biology, hydrology, sanitation and construction.

Three dimensional model of Illinois Central R. R. air right area east of Michigan Avenue between Randolph Street and the River, prepared to aid engineers in planning water system facilities to serve anticipated high-rise structures. Fire hydrants will be installed on three separate roadway levels.



DEPARTMENT OF WATER AND SEWERS



ADMINISTRATION AND FUNCTIONS

The Commissioner of Water and Sewers, as chief executive officer of the Department, is directly responsible to the Mayor and the Chicago City Council. He is assisted by the Deputy Commissioner of Water and Sewers. Each of the component Bureaus, the Bureau of Water and the Bureau of Sewers, is headed by a Deputy Commissioner.

The Bureau of Water is entrusted with the operation and maintenance of the Chicago Water System which furnishes a good quality, filtered water to all of Chicago and 72 suburbs. The Bureau is composed of five Divisions: (1) the Purification Division which operates and maintains the two largest water treatment plants in the world and monitors the water supply to insure its potability; (2) the Pumping Station Operation Division which operates and maintains four water intake cribs and eleven pumping stations; (3) the Water Distribution Division which operates and maintains the water distribution system and constructs additional water mains as needed; (4) the Meter Division which operates the meter repair shop, installs large meters, inspects and makes repairs of meters in the field and maintains complete

records on all meters; and (5) the Collection Division which reads meters in service, and bills, collects and accounts for water charges.

The Bureau of Sewers operates and maintains the Chicago Public Sewer System which collects and transports sanitary and industrial wastes and surface water drainage to the interceptor sewers of the Metropolitan Sanitary District of Greater Chicago. The Bureau is composed of the Administrative Division and five other Divisions: (1) the Engineering Division which plans and designs sewer extensions, betterments and major repairs; (2) the Cleaning Division which scrapes and flushes sewers and cleans catch basins on a district basis; (3) the Repair and Construction Division which makes repairs to the Sewer System on a district basis; (4) the Arterial Maintenance Division which cleans and repairs City arterial highway sewers; and (5) the Inspection Division which supervises sewer construction, the installation of connections and the underground work of others done near public sewers to protect the sewers from damage.

Purification

The Chicago Water System obtains its raw water either from the shore intakes of the two filtration plants or from intake cribs located about two to two and one-half miles from shore. The raw water supplied by the cribs is generally of a higher quality than water from the shore intakes, and, therefore, the cribs are used as the source of supply for a greater amount of time than the shore intakes.

The Central Water Filtration Plant, which was restricted to the use of its shore intakes until late in 1970 when the tunnel connection to the William E. Dever - Carter H. Harrison crib complex was completed, now also has two available sources of raw water supply.

Water treatment processes include: the addition of chlorine to sterilize the water; aluminum sulfate (alum) and chlorinated ferrous sulfate (iron sulfate) to aid coagulation in the precipitation and settlement of impurities; lime to reduce corrosion of pipes; anhydrous ammonia to eliminate chlorine tastes and extend the protective action of the chlorine on bacteria; activated carbon to remove other tastes and odors; and fluorides to reduce dental caries in children. A caustic soda system has been installed at the Central Water Filtration Plant, as a supplement to the use of lime to render finished water non-corrosive.

During 1970, the filtration plants supplied the Chicago Water System's eleven pumping stations with more than 377 billion gallons of treated,

filtered water for distribution to consumers in Chicago and 72 suburban communities. A total of 31,862 tons of chemicals were used in the treatment processes.

When water mains are repaired or new mains are installed, they are flushed and sterilized before they are put into service. Water samples are taken at various locations and tested by the Water Quality Surveillance Section to insure effective sterilization of the mains.

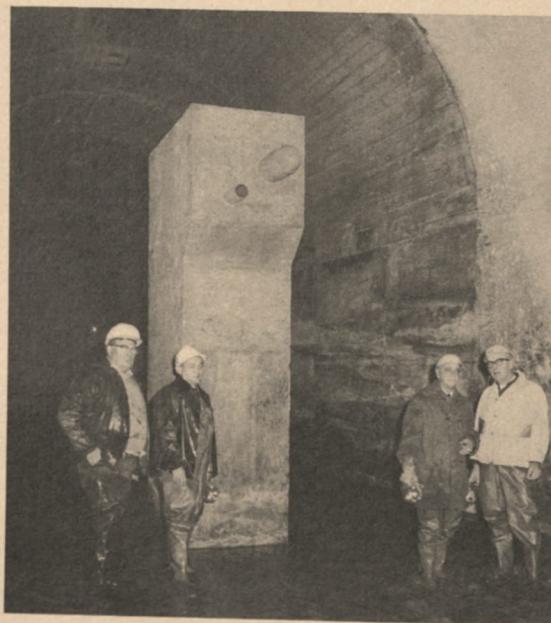
Valuable data concerning the quality of water in Lake Michigan (particularly in the Lake's southern end) and its tributaries was obtained during the year from the regular surveys conducted by the Water Quality Surveillance Section. Current information is always available to the Division so it is able to anticipate and prescribe the proper treatment of the raw water to be processed at the filtration plants.

These surveys involve the sampling of raw water at hundreds of selected points along the North and South Lake Shores, the harbors and tributary waters. Samples are analyzed in the laboratory and during 1970 the Water Purification Division made a total of 758,866 such laboratory analyses and tests.

During the year, representatives of the Department of Water and Sewers again participated actively in the Four State Conference on Pollution of Lake Michigan. On March 31, April 1, and again on September 28 through October 2, reports were submitted summarizing the comprehensive data obtained from lake surveys and laboratory analyses. These data were used at the conferences to update the Department's testimony on Lake Michigan and other basin waters.

During October and November, this Department was represented at conferences held by the State Pollution Control Board on Thermal Pollution of Lake Michigan. A member of the staff also testified before the City Council committee hearing in favor of the new ordinance which provides for the reduction and ultimate elimination of the use of phosphates in the manufacture of detergents.

One of the year's most substantial improvements in the Central Water Filtration Plant was the complete revision of the hydraulic system which operates the large discharge valves on each of the eight low-lift pumps. It is now possible



Concrete pylon containing chlorine and carbon feed lines in new 20-foot water tunnel section, 180 feet below the surface of the Lake, connecting Chicago Avenue raw water tunnel system to Central Water Filtration Plant

to isolate each individual pump from the system for repair or maintenance. Formerly, when one pump needed to be worked upon, it was necessary to isolate also the other three pumps on that side of the plant. These are the pumps that lift the raw water high enough to make it possible for it to flow by gravity on its journey through the chemical treatment and filtration processes in the plant.

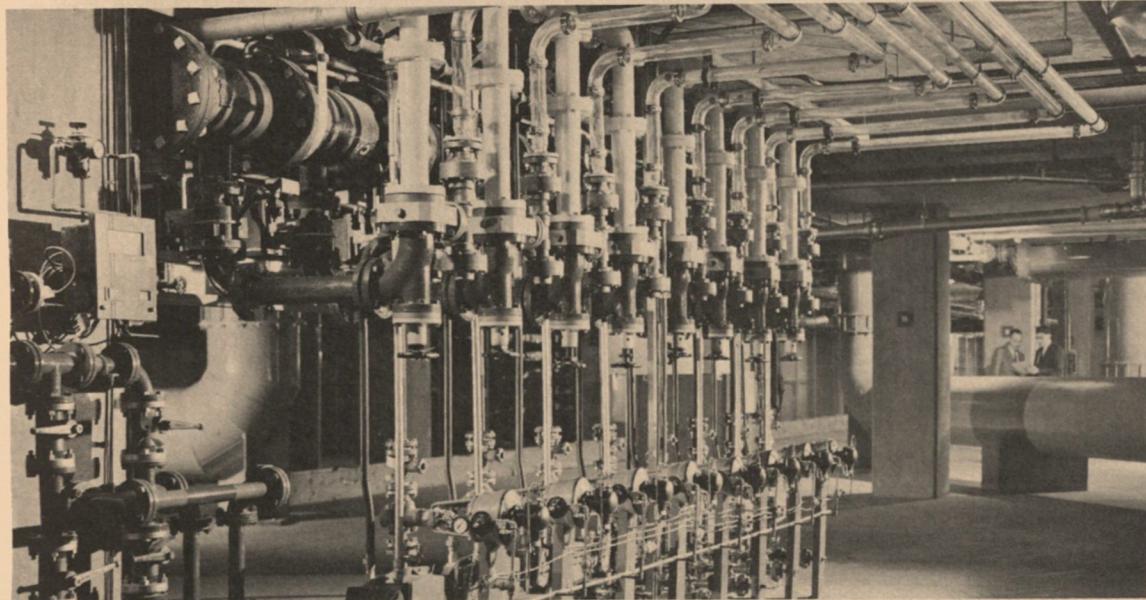
During 1970, the Department acquired new equipment to use with its atomic absorption unit in measuring mercury and other trace metals in lake water. Mercury is a highly toxic metal and with the new analytical procedure, the Water Purification Division is able to detect and measure trace metals accurately in extremely low ranges. A special chemical is added to a fixed quantity of water and this causes any mercury present to vaporize. As the mercury vapor bubbles up out of the water an airstream picks it up, blowing it through a glass tube. A beam of light is directed through the tube and a detector at the end of the tube measures the degree that the light was filtered by the mercury vapor. By comparing the results of such tests with the results of similar tests with known quantities of mercury, the amount of mercury is indicated in the water sample. So far, in tests that have been conducted, the amount of mercury in lake water was found to be less than one-tenth parts per billion parts of water. The United States Public Health Service has established a drinking water limit of 5.0

parts per billion parts of water and the State of Illinois is considering a proposed standard of 0.5 parts per billion parts of water. Either way, the level of mercury in Lake Michigan falls well below these standards. Other new research equipment for the Purification Division's laboratories includes a low background counter to detect radioactivity. The test for radioactivity is now on a continuous basis. Also, it should be explained that existing levels of radiation fall well below established Atomic Energy Commission limits.

The John R. Baylis Memorial Library and Technical Information Center at the Central Water Filtration Plant was formally dedicated on July 30, 1970. This library will contribute abundantly to research in the water industry by providing scientific and technical reference material and information to employees of the Department and to others engaged in technological research for the purpose of improving water system operations and expanding water science.

During 1970, a total of 17,053 visitors toured the Central Water Filtration Plant, the largest water treatment facility in the world.

Guides conducted the tours and most of the tourists were students at various levels of education, including many elementary school pupils. Also, about 165 foreign visitors from 21 different countries toured the plant.



Tempered glass piping carries chlorine under vacuum from chlorinator units to points of application.

CITY OF CHICAGO



RICHARD J. DALEY
MAYOR

DEPARTMENT OF WATER AND SEWERS



1 0 1 2
SCALE IN MILES

WILSON AVE. CRIB
(STAND-BY)

CARTER H. HARRISON
CRIB

WM. E. DEVER CRIB

CENTRAL WATER
FILTRATION PLANT

4 MILE CRIB
(STAND-BY)

68TH ST. CRIB

ED. F. DUNNE CRIB

SOUTH WATER
FILTRATION PLANT

●	INTAKE CRIBS—IN USE
○	INTAKE CRIBS—STAND-BY
■■■■■	WATER TUNNELS—IN USE
—	WATER TUNNELS—STAND-BY
[]	FILTRATION PLANTS
★	PUMPING STATIONS
□	RESERVOIR
—	LARGE FEEDER MAINS—EXISTING
—	LARGE FEEDER MAINS—FUTURE
■	CITY OF CHICAGO
■■■	SUBURBAN AREAS SUPPLIED BY THE CHICAGO WATER SYSTEM
*	SUBURBAN AREAS PARTIALLY SUPPLIED BY THE CHICAGO WATER SYSTEM

THE CHICAGO WATER SYSTEM SERVICE AREA - 1970

Sewers

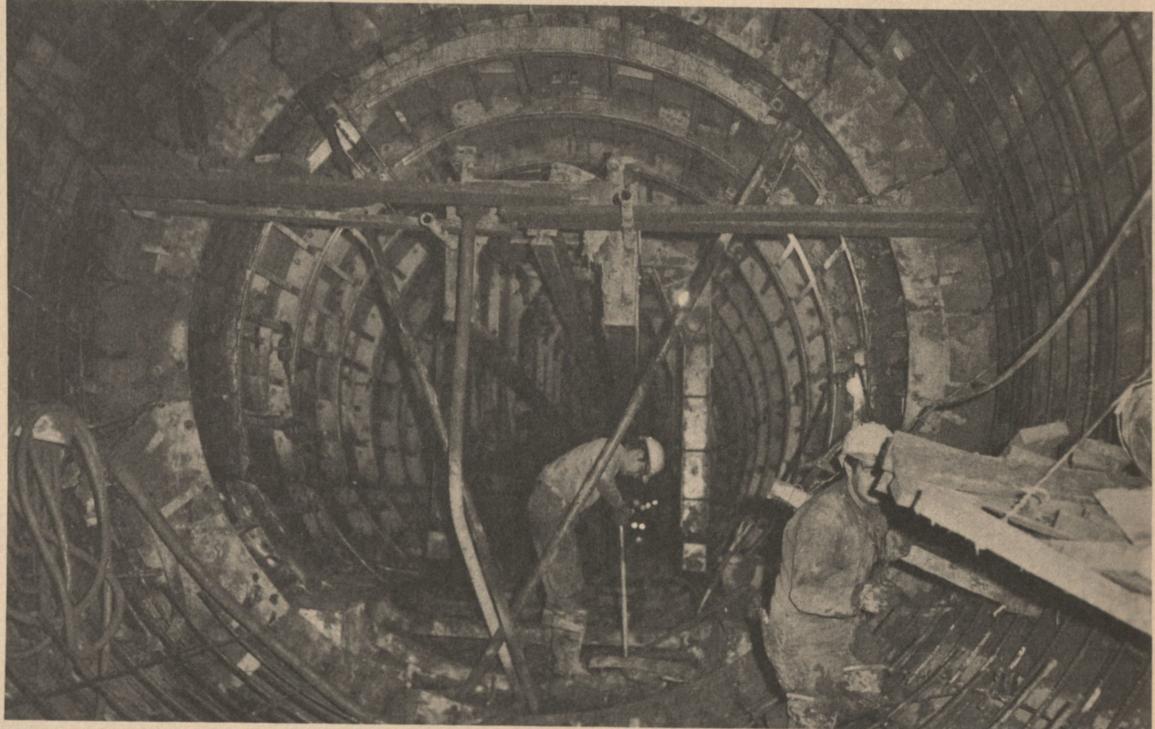
During 1837, when Chicago was incorporated as a city, it had a population of 4,170 persons and its limits included an area of about ten square miles—bounded by Lake Michigan, Wood Street, North Avenue and 22nd Street. It was in 1856, that the City initiated the construction of the first integrated sewerage system in the United States. During those 19 years, the population of Chicago had grown to 90,000.

At that time, the law provided for separate accounting of sewer taxes then imposed in the three sections of the City, so some of the original sewers were built in the Downtown Section on the South Side, some in the near North Side, and some in the near West Side. Most of these early sewers remained in service many years even though they had been subjected to severe strain caused by ground movement due to excavations during construction operations. The first sewers that were less than 24 inches in diameter were built of glazed clay pipe with ring joints; in sewers larger than 24 inches but less than 36 inches, a single ring of brick was used; and sewers with diameters from three to six feet were built of two rings of brick. It was planned at that time that six feet in diameter would be the maximum size for sewers.

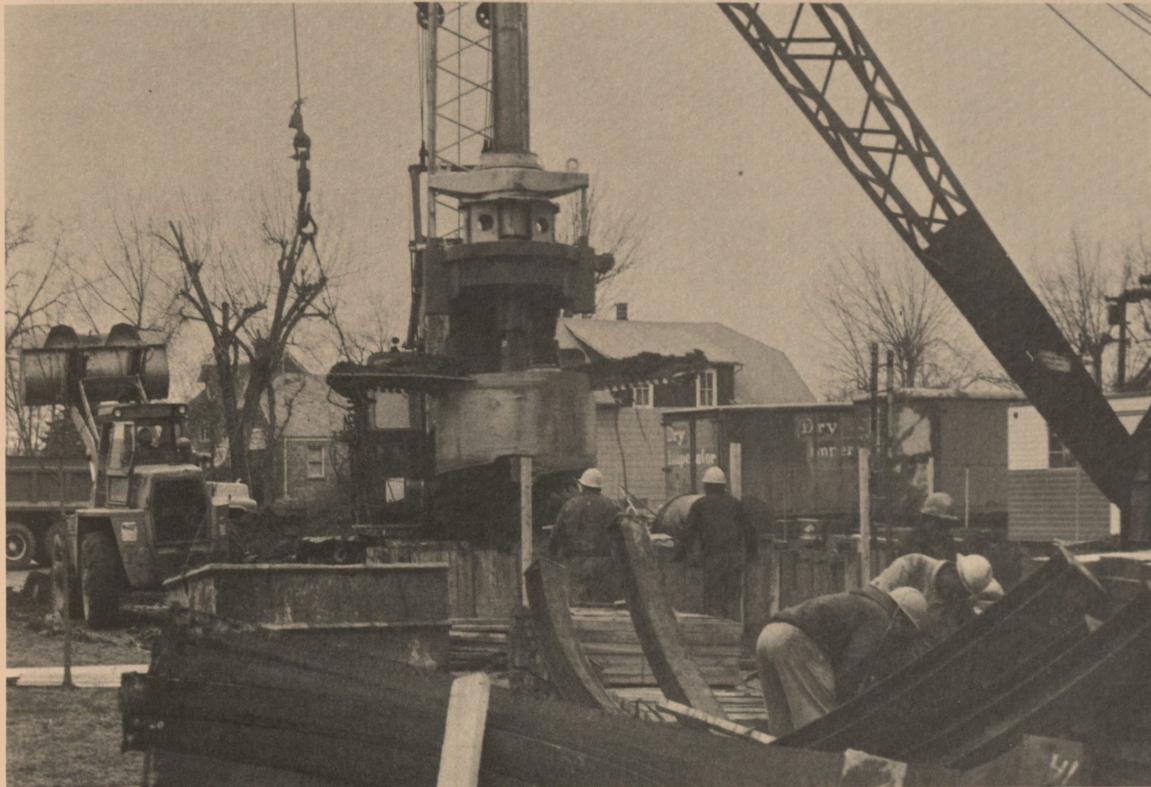
During those fledgling days of the Sewerage System, most of what is now Chicago's Loop was low and marshy. This condition was surmounted by constructing the sewers at ground level and filling in over them. Thus, the level of the Downtown area was raised from six to fourteen feet above the Lake's level to insure better drainage.

Because the establishing of public street elevations by Ordinance was so vitally important to the Chicago Sewerage System, the City Code required all Ordinances for street grades to be transmitted to the City Council through the Bureau of Sewers and it further provided that all matters concerning bench monuments be under the supervision of the Bureau of Sewers. During 1970, in compliance with the aforementioned provisions of the Municipal Code—which are still in full force and effect—the Bench and Grade Section Engineers of the Bureau ran 144 miles of precise levels to establish elevations of 246 standard bench monuments and ordinary benches and 29 new street grades.

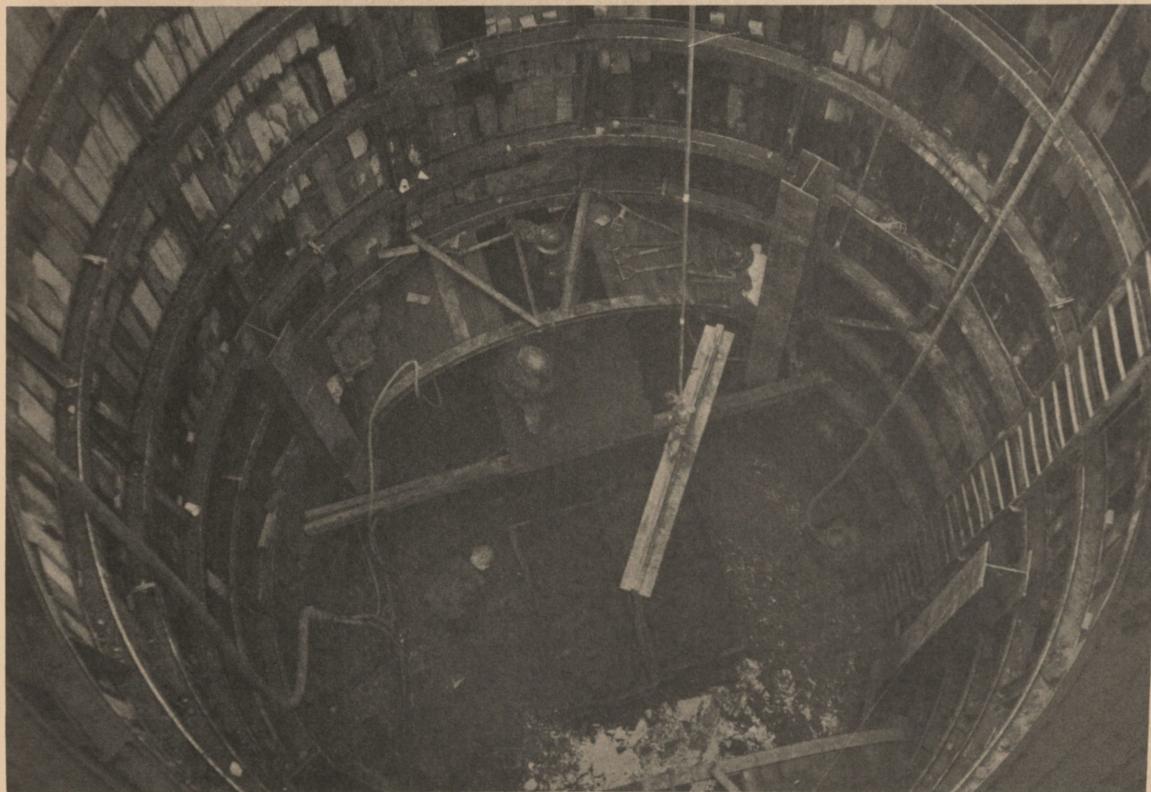
At the close of 1970, after 114 years of continuous sewer construction, the Chicago Sewer System had been expanded to include 4,107 miles of sewers, 147,271 manholes and 213,293 catch



Forms for pouring concrete and reinforcing steel rods are set in construction of huge sewer.



Enormous special auger is used to drill deep sewer shaft in construction of the Lawrence Avenue Underflow Sewerage System.



Shaft being constructed to connect with Underflow Sewer System, which tunnels through rock from 200 to 300 feet below ground.

basins. Also, during the year, cleaning and repair crews scraped 8,920,284 feet of sewers, cleaned 340,783 catch basins and performed a total of 13,786 repair jobs.

When newly constructed sewers are connected to the Sewerage System, mason inspectors are assigned to the construction projects, whether they be public or private, to insure compliance with City standards as set forth in the Municipal Code. In 1970, inspectors supervised the construction of 13.48 miles of sewers, 543 catch basins and 382 manholes.

The underflow tunnel now being constructed below Lawrence Avenue in Chicago's far northwest area will, when completed, be the first of its kind to be put in service in the United States. After more than a century of conventional sewer construction, the City of Chicago is pioneering an entirely new approach in municipal drainage. This tunnel was designed by, and is being constructed under the supervision of, the Department of Public Works. When completed, operating responsibilities will be assumed by the Bureau of Sewers.

The Underflow System is tunneled in solid rock, from 200 to 300 feet below ground. The disruption of surface traffic which would have been caused by the older, more conventional open-cut or trenching methods is minimized by following the underground mining procedure. The enormous rock-mining machine being used is guided by a laser beam and has

a giant rotating drill with rock cutters on the face that is forced against the rock surface with tremendous pressure. This is the first time that machinery has successfully drilled through limestone of such hardness. During normal periods sanitary and surface drainage of this area will continue to be collected by the existing conventional sewers and discharged into interceptor sewers of the Metropolitan Sanitary District of Greater Chicago.

However, when the capacity of the regular sewer system is exceeded, as during a heavy rainstorm, the excess runoff will be diverted into the new deep-level tunnel for temporary storage rather than overflow into the inland waterways. In this way, the large quantities of waste water will be stored until the waste water treatment plants of the Sanitary District are again able to cope with the excessive storm and sanitary flows.

The Lawrence Avenue Underflow System is regarded as a pilot project, so the City of Chicago was awarded a demonstration grant of \$1,500,000 by the United States Department of the Interior. Some 150,000 people residing in a 6,500 acre drainage area located in the regions of Irving Park, Albany Park, Forest Glen, Jefferson Park, Portage Park and Norwood Park will benefit from this System. It was designed for a discharge of 1,500 cubic feet per second, and when completed, the tunnels will contain a total storage volume of about 4,000,000 cubic feet.

THE CHICAGO SEWER SYSTEM, WHICH COLLECTS WASTE WATER FROM EVERY BUILDING IN THE CITY AND STORM WATER FROM THE STREETS, CONSISTS OF MORE THAN 4,100 MILES OF SEWERS — ENOUGH, IF PLACED IN A STRAIGHT LINE, TO SPAN THE UNITED STATES AND EXTEND EVEN BEYOND ITS EASTERN AND WESTERN COAST LINES.



A long-range combined underflow-storage plan calls for the construction of huge rock tunnels under the surface waterways which will collect and store the spillages from all existing combined sewers as well as provide outlets for underflow sewers within the entire Metropolitan Area of Chicago. It is anticipated that this plan, when carried out, will have reduced the discharge of pollutants to the waterways by 98½ per cent, and thereby meet the water quality standards for the waterways established by the Illinois Sanitary Water Board. This combined under-

flow-storage plan, when coupled with other recommended waterway improvements, will provide outlet capacity for the heaviest storm possible within the major portions of the Chicago Metropolitan Area.

In addition to the City of Chicago's Lawrence Avenue System, two other underflow sewer systems are presently under construction in the Chicago Metropolitan Area. They are the Metropolitan Sanitary District's Calumet Underflow Sewer and the Southwest Side Underflow Sewer.



Workmen install reinforcement rods before concrete is poured during construction of monolithic sewer.



Bureau of Sewers personnel repairing brick sewer.

Safety

During the early 1950's, results of plans directed toward boosting the efficiency of the City of Chicago's operational units included the establishment of the Department of Water and Sewers which began functioning as a separate organizational entity at the start of 1953.

When this new Department assumed responsibility for the provision of two vital services, its staff recognized the tremendous importance of an effective safety program. Since then, they have maintained a steadfast interest in safety engineering and accident prevention in the operations of the component Bureaus of Water and Sewers.

Chicago was one of the first large American cities to develop and put into effect a formal safety program for the purpose of protecting its employees and the general public. In 1954, during the second year of the Department's existence, it became a member of the National Safety Council. At about that time, safety committees were appointed in each of the Divisions of the Department and since then these committees have been most important contributors in the implementation of an effective safety program.

It is undeniable that a comprehensive safety program deserves a very high priority in the activities of an operating organization like the Department of Water and Sewers as a protection against human hurt and lost man hours, but it seems that the value of sound safety practices is fully appreciated only when accident frequency and severity rates are tabulated and quoted. Since the inception of the Department's safety program, however, it is to be noted that operating costs have benefited substantially by the

reduction of time lost because of accidents, and of even greater importance is, of course, the decrease in needless human suffering.

An example of accident cost reduction is provided by the Department's 1970 accident frequency rate which again compares favorably with the latest published national average for other water utilities, as reported by the National Safety Council. At the end of the year, the Bureau of Water's accident frequency rate stood at 12.34 while the most recently compiled figure available for the 1969 annual national average frequency rate was 26.03. This means that for the man-hours worked, Chicago's Department of Water and Sewers had less than one-half as many accidents as the annual average for all other water utilities in the Nation. The Department's severity rate of 1.106 for 1970 shows an improvement over its severity rate for the preceding year. (The frequency rate is determined by multiplying the number of disabling injuries by one million and then dividing the product by the number of man-hours worked during a given period. If we divide the product of one million times the number of days lost by the number of man-hours worked, we find the severity rate.)

Every accident is accurately reported by the Divisions for recording and analysis. On the basis of these reports, the Department is able to provide the United States Department of Labor, the National Safety Council and the American Water Works Association with valuable safety program data. Many other private and governmental organizations refer to this Department's Annual and Semi-Annual Accident Reports, which are sent to them upon request for use when planning their own safety programs.

Seminars are held regularly by personnel of the Department of Water and Sewers in cooperation with the Chicago Fire Department in order to intensify the Department's ongoing safety program.



In-Service Training

Few cities can match those achievements of Chicago that are attributable to its waterworks capital improvements programs. Planning for the future is one of the most vital functions of the administrative and engineering staffs of the Water System. However, plans that are concerned only with physical facilities are inevitably destined to be fruitless.

The costliest, most advanced equipment available would be wasted if it were not operated and maintained by an efficient work force. It is with this in mind that the Department of Water and Sewers, as an equal opportunity employer, stresses the importance of increasing the ability and enhancing the skills of its personnel through in-service training—to the advantage of the individual employee as well as for the benefit of the public served.

During the period covered by this Annual Report, the Department's training program was in full operation. Plans were formed to carry on at this same level of activity in some areas during 1971, and to expand in others. It has been evidenced that adequate training procedures are essential to the recruitment of certain types of technical personnel.

A program of seminars conducted in 1970 was attended by approximately 160 supervisors and technical employees of the Department. Participants became acquainted with the activities of units other than their own within the Department of Water and Sewers as well as with other departments and municipal agencies. With the background provided by these seminars, trainees were able to perform with a greater knowledge and wider understanding of City government and its functions.

Selected employees participated in pertinent technical and management seminars. These seminars were sponsored by universities and professional associations to provide the means to remain abreast of modern management practices and technology in municipal utilities.

Training resources originating outside this Department are also available to its employees. Accredited college courses that are applicable toward college degrees were financed by the Chicago Civil Service Commission through a tuition reimbursement program. Forty applicants from the Department of Water and Sewers participated in classes in the skill-improvement, public

service, and executive development programs.

Under a cooperative arrangement with colleges in the Chicago area, this Department employs—on a part-time basis and also during summer months—college students whose courses of study are in fields related to Department activities. This program provides that such students, hired as engineers-in-training and laboratory technicians, be regarded as potential full-time employees upon completion of their education. Stenographic and clerical students also are employed as clerk trainees on such a part-time basis. Included in the 1970 program were 19 college students employed as engineers or laboratory technicians, five students from the Southeast Campus of the Chicago City College enrolled in the Environmental Technology Program, five students under Mayor Daley's Students-as-Trainees Program, and 20 Clerk Trainees.

The Water Purification Division of the Bureau of Water conducts a special program of instruction for technical personnel. Two training sessions are held each month during a 10-month period for approximately 120 employees, including engineers, chemists, bacteriologists and biologists. Subjects under study are designed to increase the competency of the participants in the discharge of their job assignments.



A typical in-service training session regularly conducted by the Bureau of Sewers.



Financial Reports

CITY OF CHICAGO WATER WORKS FUNDS

PRELIMINARY COMBINED BALANCE SHEET — UTILITY BASIS

At December 31, 1970

ASSETS

Capital Assets:

Land and Land Rights		\$ 1,949,150
Utility Plant in Service	\$525,713,606	
Less Accumulated Depreciation	107,994,195	417,719,411
Construction in Progress		8,130,519
TOTAL CAPITAL ASSETS		\$427,799,080

Investment in Working Capital Funds

Current Assets:

Cash Deposited and on Hand	\$ 27,047,450	
Accounts Receivable	8,580,019	
Due from Other City Funds	73,432	
Inventories	2,051,671	
TOTAL CURRENT ASSETS		37,752,572
TOTAL ASSETS		\$473,342,906

LIABILITIES AND CITY EQUITY

City of Chicago Equity

Long Term Liabilities:

Certificates of Indebtedness	\$175,500,000	
Conditional Construction Advances	691,770	
TOTAL LONG TERM LIABILITIES		176,191,770

Current Liabilities:

Vouchers Payable	\$ 9,690,525	
Interest Payable	1,537,716	
Due Other City Funds	197,422	
Refunds and Judgments Payable	36,026	
TOTAL CURRENT LIABILITIES		11,461,689
TOTAL LIABILITIES AND CITY EQUITY		\$473,342,906

The Chicago Water System is supported entirely through revenues received from the sale of water. The System receives no funds from real estate or other tax levies. Accordingly, as a municipally owned and operated utility, water rates are designed to cover operating, maintenance and debt service costs; it is not operated for profit. Statements are prepared on both an accrual (utility) basis and on a cash (appropriation) basis.

During 1970, operating revenues received on an appropriation basis amounted to \$72,181,298. Operating and maintenance expenses, including a provision for depreciation of \$8,149,821, totalled \$58,807,303. Debt service costs of \$12,245,201 included the interest and principal payments on Certificates of Indebtedness.

The total investment in fixed assets rose from 527.7 million dollars to 535.8 million dollars during the year. While the net book value of the Chicago Water Fund's fixed assets are carried at 427.8 million dollars, it is estimated actual replacement value conservatively would exceed a billion dollars. The statements presented herein are preliminary. Final statements will be submitted by the City Comptroller in his report for 1970.

CAPITAL IMPROVEMENT PROGRAM 1970-1974

BUREAU OF WATER

Filtration Plants	\$ 18,520,000
Pumping Stations	18,322,000
Water Tunnels	35,000,000
Feeder Mains 24" dia. and larger	5,929,000
Small Mains & Miscellaneous	27,282,000
Miscellaneous	3,000,000
Total Program	\$108,053,000

BUREAU OF SEWERS†

Capital Improvements Program 1970-1974	\$ 87,990,000
Storm Water Control (O'Hare Airport)	8,621,000
Total Program	\$ 96,611,000
Total Water and Sewers	\$204,664,000

INVESTMENT IN CAPITAL IMPROVEMENTS 1953-1970

BUREAU OF WATER

Filtration Plants	\$120,495,000
Pumping Stations	51,359,055
Water Tunnels & Cribs	37,003,907
Water Mains & Distr. System	108,826,764
Total Investment*	\$317,684,726

BUREAU OF SEWERS†

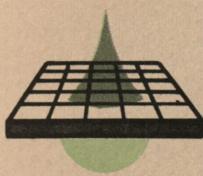
Investment in Capital Improvements	\$163,666,535
Total Water and Sewers	\$481,351,261

†Programmed under the direction of the Department of Public Works

*Does not include equipment.

CHICAGO WATER SYSTEM
INSTALLED CAPACITIES
COMPARISON 1953—1970

(In Billions of Gallons per Day)



FILTRATION

1953 .6 BGD



PUMPING

1953

2.56
BGD



TUNNELS

1953

1.92
BGD



CITY OF CHICAGO
WATER WORKS FUNDS

PRELIMINARY STATEMENT OF OPERATIONS
AND EQUITY — UTILITY BASIS
For the Year Ended December 31, 1970

Operating Revenues:

Sales of Water	\$ 71,025,639
Other Operating Revenues	1,155,659
TOTAL OPERATING REVENUES	\$ 72,181,298

Operating Expenses, Excluding Depreciation:

Source of Supply	\$ 522,129
Power and Pumping	7,751,335
Purification	9,514,206
Transmission and Distribution	15,624,357
Drainage, Maintenance and Operation	9,504,261
Consumer Accounting and Collection	2,884,818
Administration and General	4,856,376
TOTAL OPERATING EXPENSES	\$ 50,657,482

EXCLUDING DEPRECIATION

Operating Income Before Depreciation	\$ 21,523,816
Depreciation Expense	8,149,821
Operating Income	\$ 13,373,995

Add Non-Operating Income

Deduct Non-Operating Expense:	
Net Interest on Water Certificates	\$ 5,745,201
Other Non-Operating Expenses	65,160

	<u>5,810,361</u>
--	------------------

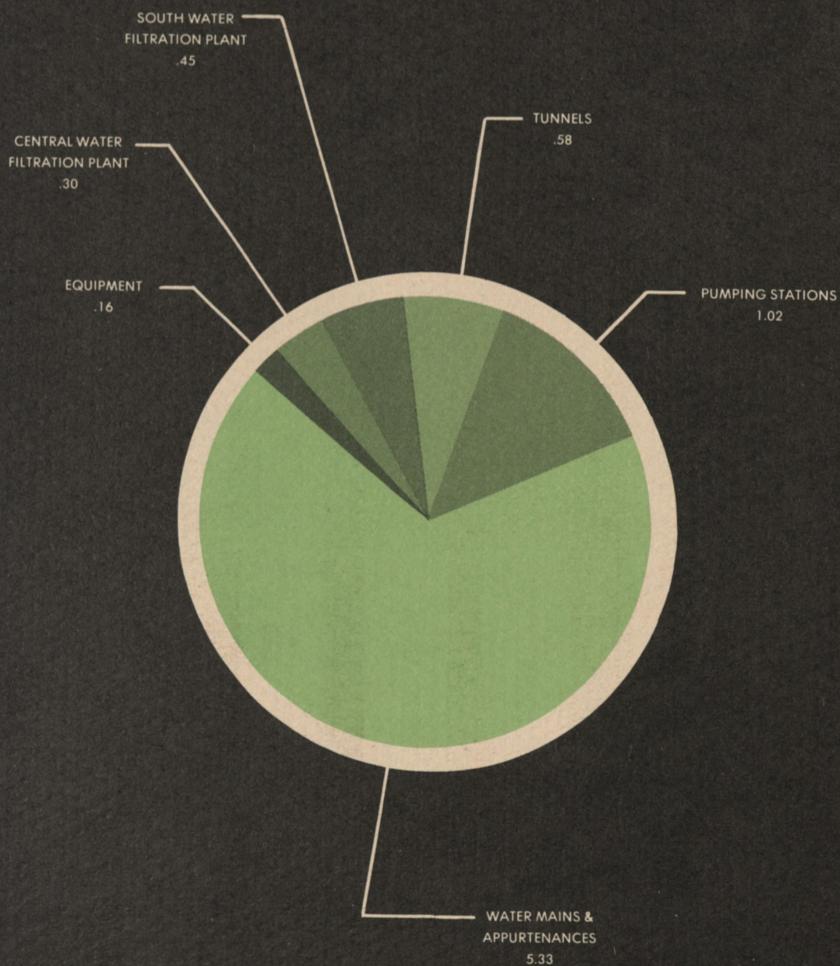
Balance after Non-Operating Transactions

Operations of Working Capital Funds	\$ 7,660,785
Income in Excess of Expenses	(232,507)
	\$ 7,428,278

CITY EQUITY, JANUARY 1, 1970

Add Surplus Adjustments	<u>11,654</u>
CITY EQUITY, DECEMBER 31, 1970	\$ 285,689,447

CAPITAL EXPENDITURES 1970
IN MILLIONS OF DOLLARS
(TOTAL \$7,847,529.00)



CAPITAL IMPROVEMENTS
PROGRAM

Nearly eight million dollars was invested in the Chicago Water System during 1970 in keeping with the ongoing program of new and expanded services in the System's plants and facilities. Included in the \$5,330,770 expended for water mains and appurtenances is a project for a major 60-inch feeder main, approximately eight miles in length at completion, which will improve service to the Northwest area including suburban communities. Another \$1,024,397 was invested in improving the System's pumping stations with one of the primary objectives being the conversion of boiler equipment in the steam-operated stations from coal to natural gas in keeping with Chicago's drive for cleaner air. In the \$575,771 invested for tunnels, is the completion of the Oak Street shaft and raw water connection, as well as construction of an 800 foot tunnel and shaft at Springfield Avenue which, coupled with removal of the wet well, allows a greater flexibility of the System. Investments in the world's two largest water filtration plants totalled \$755,854 and included improvements to the high-pressure hydraulic system for the low-lift pumps as well as additions and expansion of chemical treatment facilities. New equipment accounted for \$160,735 in purchases.

The preliminary Five-Year Capital Improvement Program for the Chicago Water System, which was planned in cooperation with the Departments of Public Works and Development and Planning, covers the period from 1970 to 1974. Subject to annual revisions and approval by the City Council, the program provides for a total investment of \$108,053,000, which will include \$35,000,000 for tunnels and shafts; \$18,520,000 for the filtration plants; \$18,322,000 for pumping stations; and \$36,211,000 for water main construction.

CITY OF CHICAGO
WATER WORKS FUNDS

STATEMENT OF
SOURCES AND USES OF CASH - APPROPRIATION BASIS
For the Year Ended December 31, 1970

	Detail	Amount	%
CASH BALANCE, JANUARY 1, 1970		\$ 4,282,876	

CASH RECEIVED FROM:

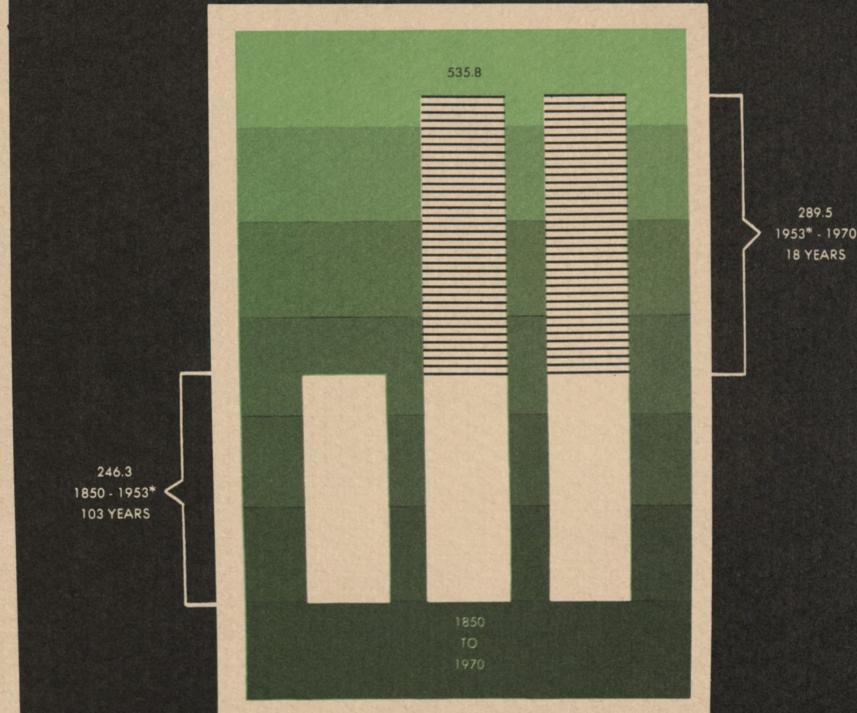
Sale of Water:			
Loop and Large Commercial Users	\$17,211,865	18.17	
Large Industrial Users	11,571,095	12.22	
Small Consumers	10,964,141	11.57	
Suburban Consumers	<u>15,936,705</u>	<u>16.82</u>	
Total from Metered Sales	\$55,683,806	58.78	
Single & Double Unit Residential Dwellings	<u>12,754,498</u>	<u>13.46</u>	
Total Cash from Sales of Water	\$68,438,304	72.24	
Permits, Rentals, Reimbursements, Financial Income, Sale of Salvage, and various other Cash Received	1,245,031	1.31	
Proceeds from Sale of Certificates	<u>25,053,305</u>	<u>26.45</u>	
Total Cash Received	<u>94,736,640</u>	<u>100.00</u>	
Total Cash Available During 1970	\$99,019,516		

CASH USED FOR:

Source of Supply	\$ 451,103	.63	
Power and Pumping	8,506,772	11.82	
Purification	9,866,968	13.71	
Transmission and Distribution	15,888,625	22.07	
Drainage, Maintenance and Operation	10,392,417	14.44	
Consumer Accounting and Collection	3,181,102	4.42	
Administration and General	<u>3,531,706</u>	<u>4.91</u>	
Total Operating Expenses	\$ 51,818,693	72.00	
Debt Service			
Retirement of Long Term Debt	\$ 6,500,000	9.03	
Interest Paid	<u>5,748,750</u>	<u>7.99</u>	
Total Debt Service	12,248,750	17.02	
Refund of WPX Certificates	57,094	.08	
Capital Improvements	<u>7,847,529</u>	<u>10.90</u>	
Total Cash Disbursement	<u>71,972,066</u>	<u>100.00</u>	

CASH BALANCE, DECEMBER 31, 1970	\$27,047,450
------------------------------------	--------------

INVESTMENT IN FIXED ASSETS
1850 TO 1970
IN MILLIONS OF DOLLARS



*THE DEPARTMENT OF WATER & SEWERS WAS ESTABLISHED AS A
SEPARATE ENTITY IN 1953



Major Statistics for 1970

SEWERS

Existing Sewer System

Miles of Sewer	4106.82
Catch Basins	213,293
Manholes	147,271

1970 New Sewer Construction

Miles of Sewers—all sizes	13.48
Catch Basins	543
Manholes	382

Inspections.....

159,295

Complaints Handled

52,429

Repairs

Total Number of Sewer System Repair Jobs .	13,786
Main Sewer Breaks	738
Catch Basins	10,592
Manholes	1,965
Gutter Grates and Basin Outlets	491

Cleaning

Sewers Scraped—Feet	8,920,284
Catch Basins Cleaned	340,783

Street Grades Established and Approved by City Council

29

Standard Bench Monuments and Ordinary Benches Established

246

Receipts

House Drain Permit Fees	\$ 67,400
Other Permit Fees	54,511
Special Deposits	118,078
Out-of-Town Connection Fees	77,484
Drain Layers' License Fees	36,225
Total Receipts	\$ 353,698

Population and Area Served

(Based on Reliable Estimates)

Population supplied:

Chicago (1970 U.S. Census 3,366,957)	3,367,000
Suburban (Year-end census as revised).....	1,139,000
Total.....	4,506,000

Area served (in square miles):

Chicago	227
Seventy-two suburbs.....	213
Total.....	440

Per Capita Consumption

Gallons
Per Day

Chicago	257
Suburban	147
Average	230

Chemical and Physical Qualities of Water at Intake (Central Water Filtration Plant)

Total hardness (as parts per million Calcium Carbonate).....	131
Water temperatures: Intake	
Average	49.0°F.
Maximum	74.0°F.
Minimum	32.0°F.

Pumpage

Annual	Gallons
Chicago	316,444,000,000
Suburban communities and industries (metered).....	61,192,300,000
Total*	377,636,300,000

*(Amount through
Western Ave. Reservoir 1,323,130,000)

Annual Metered Consumption in Chicago
(52.5%† of Chicago pumpage) 166,047,200,000

†Percentage of Revenue
from Metered rates: 81.4%

Daily

Total daily average.....	1,034,600,000
Maximum day, July 1.....	1,723,450,000
Maximum hour (rate) July 1, 4:00 P.M.....	2,300,000,000
Daily Average—Chicago.....	866,900,000
Daily Average—Suburban.....	167,700,000

WATER

Purity Control

Laboratory tests made:	
Microbiology Laboratory.....	217,169
Microscopy Laboratory.....	12,690
Chemical Laboratory.....	113,522
Control Laboratory S.W.F.P.....	151,282
Control Laboratory C.W.F.P.....	264,203
Total tests made.....	758,866

Bacteriological Results

Annual average coliform organisms per 100 ml*

	North & Central			
	South District		District	
	Crib	Shore	Crib	Shore
Raw (MPN)	20.0	17.0	—	64
Plant Outlet (MF)*	0.01		0.004	
Pumping Stations (MF)*	0.003		0.001	
on Distribution Systems (MF)*	0.055		0.010	

*U.S. Public Health Service Standards for safe drinking water by the membrane filter (MF) technique specifies that the arithmetic mean of all standard samples examined each month shall not exceed 1.0 coliform organisms per 100 ml.

Purification Treatment

	Gallons
Complete Filtration Treatment.....	391,814,000,000

Chemicals Applied – Tons

	SWFP	CWFP
Chlorine.....	1,286	2,241
Aluminum Sulfate (17% Al ₂ O ₃).....	4,492	8,321
Activated Carbon.....	768	1,089
Lime (as CaO)	2,052	3,162
Ferrous Sulfate (as FeSO ₄).....	1,561	3,167
Anhydrous Ammonia.....	192	189
Hydrofluosilicic Acid (As Fluorine).....	557	871
Caustic Soda (NAOH).....	—	1,914

Supply

Crib intakes in service.....	3
Crib intakes on stand-by service.....	1
Shore intakes.....	2
Miles of water supply tunnels under lake and land (6 to 20 feet in diameter).....	72.6

Pumping

Pumping stations.....	11
Pumps available for service.....	53
Installed pumping capacity (Million gallons per day).....	2,995

Annual Pumpage

	Million Gallons
By electrically driven pumps.....	152,786
By steam driven pumps.....	224,850
Total annual pumpage.....	377,636
Coal used by steam powered pumps (tons).....	100,165
Electric power used by electrically powered pumps (kilowatt hrs.).....	78,839,737
Oil (Gallons).....	974,249
Gas (Therms).....	4,833,207

Distribution

Water Mains: (in miles)

In use — December 31, 1970.....	4,134.73
Extended.....	17.39
Abandoned.....	10.49
Net addition to system.....	6.90
Diameter of pipe (inches).....	4 to 60

Fire Hydrants:

In use — December 31, 1970.....	46,024
Installed.....	165
Abandoned.....	98
Net Increase.....	67

Valves:

In use — December 31, 1970.....	43,088
Installed.....	281
Abandoned.....	174
Net Increase.....	107

Pressure range in mains (lbs. per square inch).....

28 to 58

Average pressure at curb (lbs. per square inch).....	36
Miles of pipe tested for underground leakage.....	2,921.62
Premises inspected — house to house leakage survey.....	37,614
Repaired main breaks — 4 inch to 48 inch in diameter	359

Meters

In service — December 31, 1970.....	164,884
Installed by Master Plumbers.....	1,128
Installed by Water Distribution Division.....	44
Total.....	1,172
Removed.....	665
Net Increase.....	507
Repaired on premises.....	15,340
Repaired in shops.....	13,894
Tested.....	15,080
Non-metered (assessed rate) services.....	348,135
Total Services (assessed & metered).....	513,019

Supplements covering complete 1970 water or sewer statistics are available upon request.

1970

ANNUAL REPORT • DEPARTMENT OF WATER AND SEWERS • CITY OF CHICAGO



FUTURE GROWTH

UNIVERSITY OF ILLINOIS-URBANA



3 0112 114157628

